



Indiana Department of Education
SUPPORTING STUDENT SUCCESS

Games in Education

21st Century Learning Lab
January 26, 2011

21st Century Learning Lab

- Launched in September
- Topical Exploration of Educational Technology (Podcasts, Webinars, Blogs, LC Communities)
- Upcoming Topics
 - Assistive Technology
 - Copyright in the Information Age
 - Technology in the Fine Arts
 - Virtual and Online Learning
- Subscribe to podcast and see updates in iTunes



21st Century Learning Lab

- Upcoming Webinar Dates
 - Assistive Technology – February 23rd
 - Copyright in the Information Age – March 23rd
 - Technology in the Fine Arts Classroom – April 27th
 - Virtual and Online Learning – May 18th

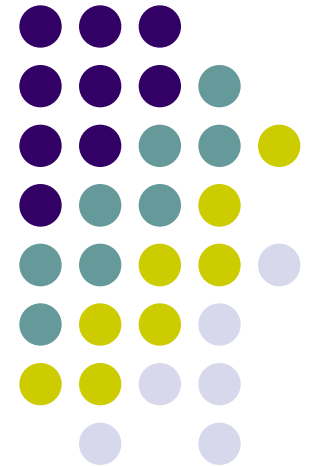


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AstroEngineer: Moon Rover™

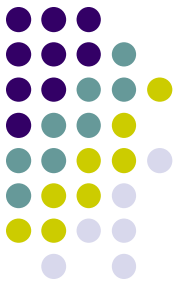


Engaging Middle School
Learners in STEM through a
Serious Game & Curriculum

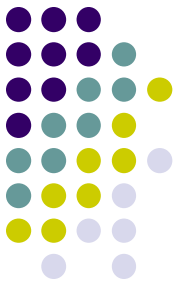


The Challenge of STEM

(Science, Math, Engineering & Mathematics)



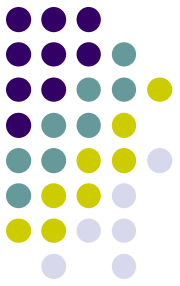
- U.S. is not able to fill STEM-related job positions due to lack of STEM graduates
- Many students lose interest in STEM-related courses at the middle and high school levels
- Minority and female students are more likely to discontinue taking STEM related courses
(National Center for Education Statistics, 2005)
- Minorities underrepresented in science, technology, engineering & math jobs (Leslie, 1998)



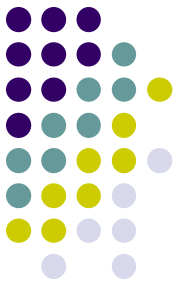
Serious Games

- Serious games are seen as way to engage students in both complex and core concepts (e.g., systems thinking, design challenges)
- Serious games: Video games used for purposes *other than entertainment*, such as education/training (i.e, military and corporate), healthcare & social change
 - Existing Video Games Repurposed: *SimCity*, *Oregon Trail*
 - Serious Games: *ReMission*, *Darfur is Dying*, *NASA MMOG*

Advantages of Serious Games



- Powerful way to teach the *digital natives*
- Address “hard to teach” concepts
- Engagement in real world challenges
- Seen as way to engage girls and minorities in key areas of STEM (see work of Carrie Heeter and Yasmin Kafai on girls and games)
- Seen as way to re-engage boys in learning
http://www.ted.com/talks/ali_carr_chellman_gaming_to_re_engage_boys_in_learning.html
- Games have natural ties to inquiry and problem based learning (Annetta, Cook & Schultz, 2007; Kiili, 2005; Maxwell et al, 2004)
- Use of educational and curriculum design approaches to ensure alignment of game with learning objectives and standards (e.g., Backwards Design)

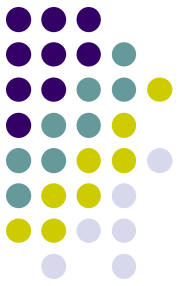


Serious Games in Education

- Just a few examples of SGs being used in classrooms that have had positive results:
 - iCivics suite of games <http://icivics.org>
 - Selene (lunar science game) <http://selene.cet.edu/>
 - Whyville
 - PBS's CyberChase
 - Kidscom <http://kidscom.com>
 - Indiana University's Quest Atlantis <http://atlantis.crlt.indiana.edu/>
 - Wolfquest <http://www.wolfquest.org/>
 - Purdue Serious Math Games
 - Oceana: A Virtual Democracy
 - AstroEngineer: Moon Rover (<http://space.wisdomtools.com>)

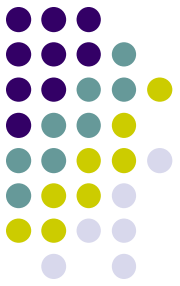
Case Study:

AstroEngineer: Moon Rover™

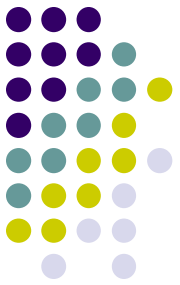


- Targeted for 7th & 8th grade students
- Moon Rover includes:
 - A serious game module with 5 missions and ~5 hours of game play
 - A teacher and student guide
 - Technical and curriculum support
- Learning outcomes mapped to national academic standards (ITEA and AAAS)
- Designed to be used on typical school computers (PC, MAC & mobile)

AstroEngineer: Moon Rover™

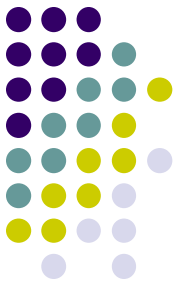


- Developed in partnership with *Project Lead the Way (PLTW)*, a non profit that provides middle and high engineering curriculum to schools in all 50 states
- *AstroEngineer* game and curriculum is now part of Unit 4 of PLTW's *Gateway to Technology*® middle school engineering curriculum



Background of Game

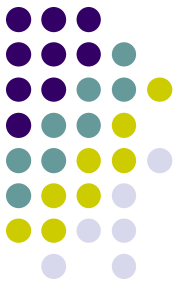
- Set 30 years in the future, the player is aboard the Goliath, a manned lunar mobile base stationed near the Mare Humorum
- Core challenge in the game is design, test, and redesign a lunar rover based on specific engineering design criteria and constraints.
- Players design smaller rovers; confronted with authentic lunar terrain, hazards, and environmental conditions



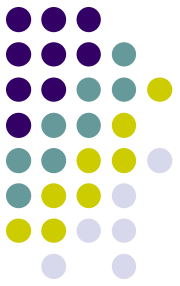
Background of Game

- The mission structure includes:
 - One day of character creation and tutorial to orient players to their rovers
 - 3 days of travel over varying conditions (day, night, and temperature)
 - One final day of rescue operations

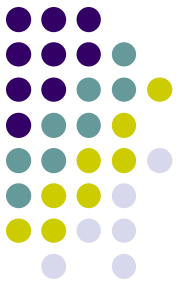
Overall Mission



Avatar Creation



Engineering Design Process

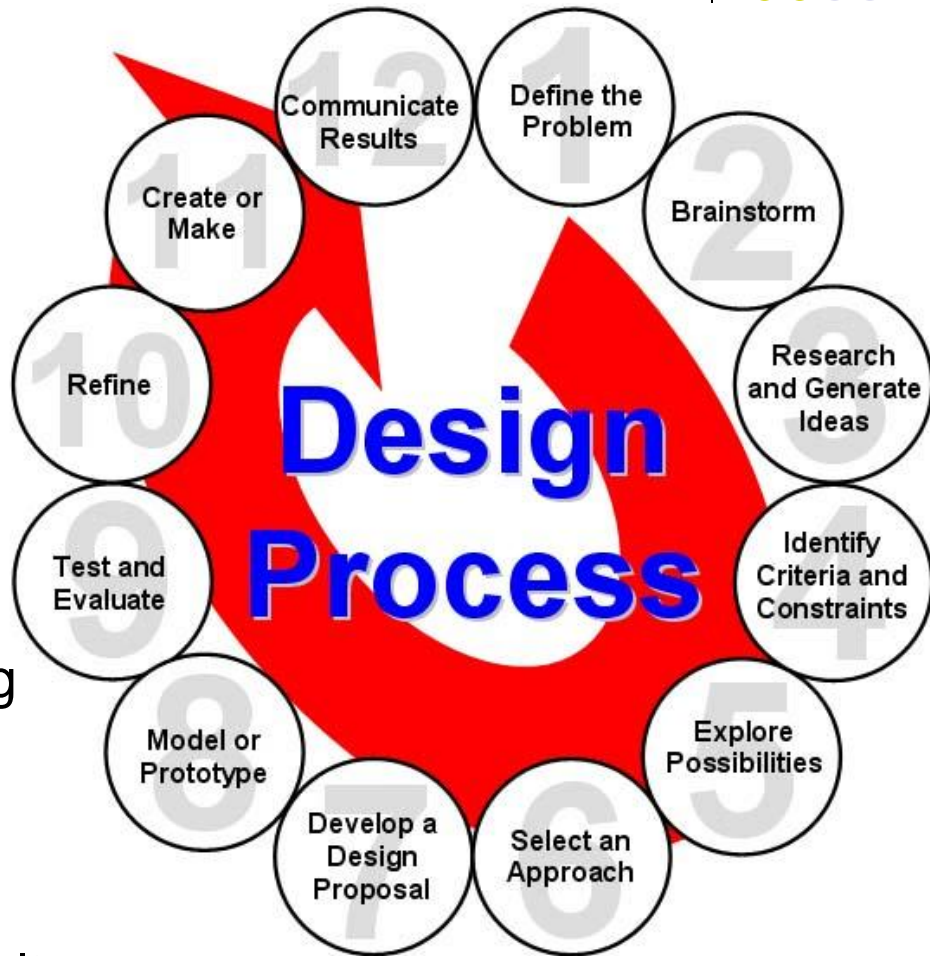


- Learning objectives focus on engineering and lunar science
- Learners use of the engineering design process to :
 - Analyze mission requirements and key design criteria/constraints for an unmanned lunar rover
 - Design a rover to meet mission requirements by choosing among various parts (e.g., body type, wheel type, power source, and sensors)
 - Test the rover by driving it over an authentic lunar surface and under realistic conditions (used real terrain maps of the Moon)
 - Redesign the rover until the mission is successful and then move on to the next mission

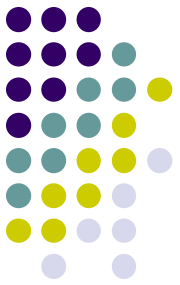


Example: Design Process

1. Define a Problem
2. Brainstorm
3. Research and Generate Ideas
4. Identify Criteria and Specify Constraints
5. Explore Possibilities
6. Select an Approach
7. Develop a Design Proposal
8. Make a Model or Prototype
9. Test and Evaluate the Design using Specifications
10. Refine the Design
11. Create or Make Solution
12. Communicate Processes and Results



Rover Construction Area



Available Parts

Engine

Solar Cell Engine

Body

Class: Hyperion

Tire


Stud Tire

Power

Nano Battery


Sensor

Radiometer



Rover GT (Modified)


Rover Creation Station



Body

Stripes

Light




←

WEIGHT: 3200kg / 7040lbs
POWER: 500
TOP SPEED: 23km/h /
14.2945mph
COST: \$87920 USD

→

Part Information



Ice:

Regolith:

Rocky:

Weight:

Cost:

\$502 USD

Stud Tire

An advanced polymer tire with small rounded metal studs placed along the surface.

Tutorial, Leg 3 Information

Briefing

Leaderboard

Journal

Load Rover

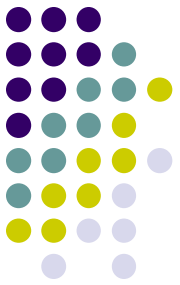
Primary Mission: Design and build your rover and guide it through the course. Use your surface radar to locate and avoid hazards on the lunar surface. Pay attention to the energy costs and trade-offs of each sensor array!

Secondary Mission: None

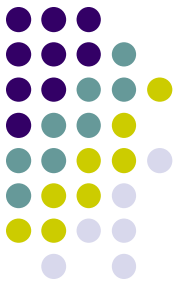
Back

Start Mission

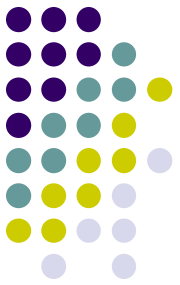
Test Your Rover Design



Game Play Options



Mission Feedback Screen



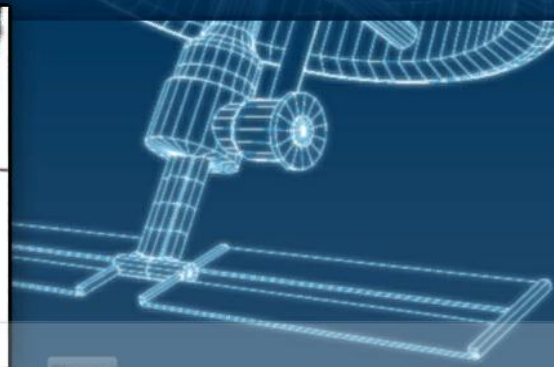
Mission One: Leg Four



Good run, cadet - the Goliath was able to make it through with only a few scratches! But don't relax too much because we're still under a time constraint to stay ahead of that shower. Between the sun getting hotter and the extra dust from the **meteoroids**, you will have to be careful not to overheat.

Our next destination is the Leibig crater and there a lot of rocks and craters between it and us, so you're also going to have to balance speed and insulation with durability. We've equipped the rovers with a new ability called "heat flush" that releases a one-time coolant over the engine. This will power down the rover for a few seconds, but your temperature will rapidly drop to 25 degrees Celcius. Heat flush will also drain a lot of your battery power, so only use it in an emergency.

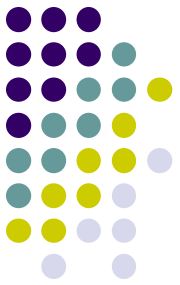
We're giving you two and a half minutes to make it through, and then we'll power the rover down until we can pick it up on our way by. If you don't make it on this run we'll have you try again in another rover.



Closest

Next

AstroEngineer Leaderboard



Mission 1, Leg 5 Information

Briefing Leaderboard

Journal Load Rover

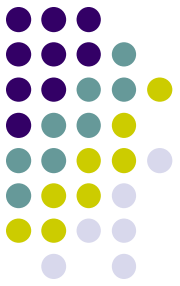
Local Global

< Completion Time >

Rank	Player	Completion Time	Cost
1	IIP100	1:26	\$97822 USD
2	IIP1000	1:38	\$21 USD
3	IIP100	1:38	\$97822 USD
4	IIP1000	1:40	\$25 USD
5	IIP1000	1:42	\$22 USD
6	IIP1000	1:43	\$25 USD
7	rob	1:51	\$25 USD

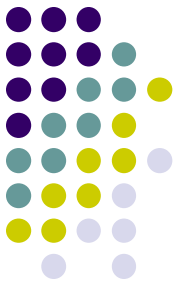
Back Start Mission

Supporting Educators



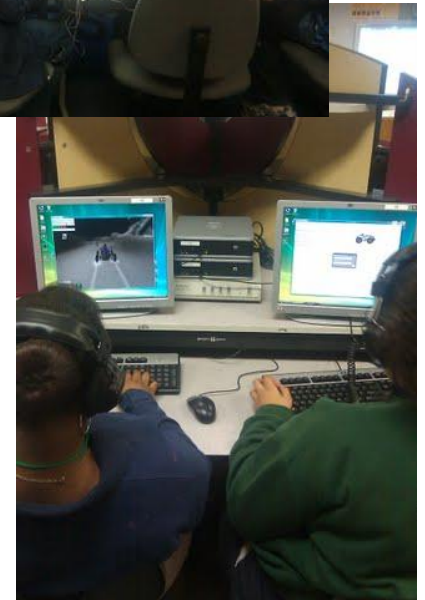
- *AstroEngineer: Moon Rover™* includes curriculum support
 - Teacher Guide
 - Student Guide
 - FAQs
 - Lesson plans
 - Enrichment activities

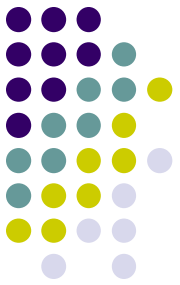




Classroom Implementation

- One week of instructional time
- In a traditional 50 minute period, students are expected to complete about 1 mission per day
- On block schedules students can complete 2-3 missions per day.



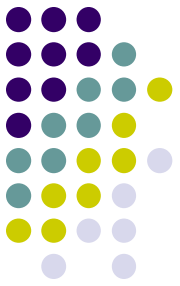


Traditional Periods

- 10 minutes of briefing
 - *How can the different design choices that you make impact your rover's performance?*
 - *What factors influence the design choices that you make?*
 - *What strategies can you use to improve your rover design?*
- 30 minutes of play time
- 10 minutes of debriefing
 - *What was the core mission today?*
 - *What design criteria you were given?*
 - *What design constraints did you encounter?*
 - *How did you optimize your design?*

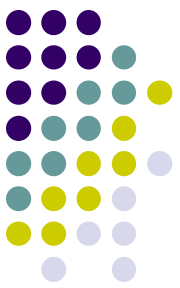
AstroEngineer: Moon Rover™ :

Research Results

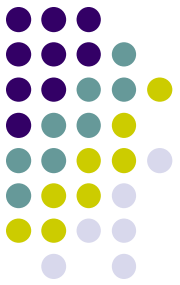


- Pre/post quasi-experimental study conducted with 341 middle school students (~equal number of males/females; racially diverse population)
 - Females = 54.4% of sample
 - Males = 45.6% of sample
- Students played for ~2 hours (113 minutes) over one week period, or 45.2% of overall class time; does not include game introduction and debriefing sessions

AstroEngineer: Moon Rover : **Research Results**

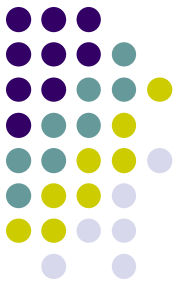


- Analysis of variance (ANOVA) was conducted to examine pre/post differences
- Results indicated statistically significant differences in learning between the pre- and post-test ($F [1, 681] = 475.135, p < .001$, partial eta-squared = .411), with higher scores on the post-test
- Both male and female students provided positive feedback on the game's design, ease of use, and graphics



Current Status

- *AstroEngineer* released in August 2010 to over 6000 PTLW teachers and 60,000 students
- Preparing for rollouts to:
 - NASA Summer of Innovation Program
 - Middle schools across the nation
 - After school programs and summer camps
- *AstroEngineer* can now be purchased and downloaded from:
<http://space.wisdomtools.com>



Contact Information

- *AstroEngineer* Website
 - <http://space.wisdomtools.com>
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- WisdomTools Inc.
 - 501 N Morton St, Ste 206
 - Bloomington IN 47404
 - 812-856-4202

ASTROENGINEERING GAME EXPERIENCE AT BELLMONT MIDDLE SCHOOL

Director: Karrie Hamilton

Teacher: Keith Dicke

In the Classroom

- ▣ Students were each given a folder that contained their username and password.
- ▣ Students were given log sheets that were filled out before and after a mission.
- ▣ Log sheets were reviewed in order to identify the problem and seek solutions.
- ▣ Students independently worked, but consistently interacted with classmates to solve problems.
- ▣ Whole group discussion at the end of each class (common problems, solutions, self/peer tracking)

Student Engagement

- ▣ Tracked and recorded data
- ▣ Shared experiences with classmates
- ▣ Independently struggled to solve problems
- ▣ Collaborated as a group at the end of each session in order to share difficulties, successes, and pose questions.
- ▣ Trial and error

Student Learning

- ▣ Learned new ways of using the keyboard
- ▣ Engineering and Space terms and concepts
- ▣ Social interactions led to cohesion within the group (different grade levels and social groups were collaborating)
- ▣ Learned to identify problem, look for solutions, and try again.
- ▣ There are things to be gained from failing (identifying weaknesses in order to do better next time).

Suggestions

- ▣ Great opportunity to have students learn charting and graphing.
- ▣ There was not enough time to get through the game when meeting once a week for 9 weeks.
- ▣ This could easily be done over a semester, which would allow the use of other enrichment activities.
- ▣ Outside of the game, incorporate other topics (metric system, measurement, temperature, vehicle systems, geology, space, engineering, etc.)